PATENT

CLAIMS

What is claimed is:

5   1.   A signal separation method, comprising:

detecting a composite electrical signal at a subcutaneous non-intrathoracic location, the composite electrical signal associated with a plurality of sources;

receiving information associated with a non-electrophysiological cardiac source;

10   separating a signal from the composite electrical signal; and

identifying the separated signal as a cardiac signal using the separated signal and the non-electrophysiological cardiac source information.

2.   The method of claim 1, wherein identifying the separated signal as the

15   cardiac signal comprises providing a detection window defined by a start time and a stop time determined using the non-electrophysiological cardiac source information.

3.   The method of claim 2, further comprising detecting a QRS complex within the detection window.

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4.   The method of claim 1, wherein the non-electrophysiological cardiac source information comprises acoustic emission information.

5.   The method of claim 1, wherein the non-electrophysiological cardiac

25   source information comprises a temporal location of a peak heart-sound.

6.   The method of claim 5, wherein identifying the separated signal as the cardiac signal comprises providing a detection window defined by a start time preceding the temporal location of a peak heart-sound.

5   7.   The method of claim 1, wherein the non-electrophysiological cardiac source information comprises blood-flow information.

8.   The method of claim 1, wherein the non-electrophysiological cardiac source information comprises pulse pressure information.

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9.   The method of claim 1, wherein the non-electrophysiological cardiac source information comprises pulse oximetry information.

10.   The method of claim 1, wherein the non-electrophysiological cardiac
15   source information comprises transthoracic impedance information.

11.   The method of claim 1, wherein identifying the separated signal as the cardiac signal comprises providing a detection window within which the cardiac signal is correlated to a signal associated with the non-electrophysiological cardiac
20   source.

12.   The method of claim 1, further comprising determining a time separation between a peak of the separated signal and a peak of a signal associated with the non-electrophysiological cardiac source.

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13.   The method of claim 12, wherein the time separation is used to identify a cardiac signal.

14.   The method of claim 1, wherein the signal is separated from the composite electrical signal using blind source separation.

15.   The method of claim 14, wherein the blind source separation comprises an independent component analysis performed on the composite electrical signal.

16.   The method of claim 1, further comprising detecting a cardiac condition using the separated signal.

17.   The method of claim 1, further comprising detecting a cardiac condition using the separated signal by performing a correlation between the separated signal and a signal assiociated with the non-electrophysiological cardiac source.

18.   The method of claim 1, further comprising detecting a cardiac arrhythmia using the cardiac signal.

19.   The method of claim 18, further comprising treating the cardiac arrhythmia.

20.   An implantable subcutaneous device, comprising:

a housing;

a plurality of subcutaneous non-intrathoracic electrodes configured to sense a

5   plurality of electrical signals;

a sensor that senses a non-electrophysiologic signal; and

a signal processor provided in the housing and coupled to the sensor and the

plurality of subcutaneous non-intrathoracic electrodes, the processor initiating a

detection window at a start time determined from use of the non-electrophysiologic

10   signal, the processor identifying a cardiac signal from the plurality of electrical signals

using the detection window.

21.   The device of claim 20, wherein the sensor comprises an

accelerometer.

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22.   The device of claim 20, wherein the sensor comprises an acoustic

transducer.

23.   The device of claim 20, wherein the sensor is provided in or on the

20   housing.

24.   The device of claim 23, wherein the sensor comprises a microphone.

25.   The device of claim 20, further comprising a lead coupled to the

25   plurality of subcutaneous non-intrathoracic electrodes.

26.   The device of claim 20, further comprising a plurality of leads, wherein

at least one of the plurality of leads is coupled to an array of electrodes.

27.   The device of claim 20, further comprising energy delivery circuitry configured to deliver a cardiac therapy.

5   28.   The device of claim 27, wherein the cardiac therapy comprises a cardiac pacing therapy.

29.   The device of claim 27, wherein the cardiac therapy comprises a cardiac defibrillation therapy.

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30.   An implantable device, comprising:

means for subcutaneously detecting a composite electrical signal associated with a plurality of signal sources;

means for subcutaneously detecting non-electrical cardiac activity;

15   means for separating a signal from the composite electrical signal; and

means for determining whether or not the separated signal is a cardiac electrical signal using the detected non-electrical cardiac activity.

31.   The device of claim 30, wherein the determining means comprises

20   means for performing a time correlation between the separated signal and a signal associated with the detected non-electrical cardiac activity.

32.   The device of claim 30, wherein the determining means comprises means for evaluating the separated signal within a detection window.

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33.   The device of claim 32, further comprising means for determining a start time to initiate the detection window.

34.   The device of claim 30, further comprising means for detecting an arrhythmia using the cardiac electrical signal.

35.   The device of claim 34, further comprising means for treating the
5   arrhythmia.

36.   The device of claim 30, further comprising means for discriminating cardiac rhythms.

10   37.   A signal detection method, comprising:
        detecting an electrical signal at a subcutaneous location, the electrical signal associated with a plurality of sources;
        receiving information associated with non-electrical cardiac activity;
        examining a portion of the electrical signal during a time duration defined at
15   least partially prior to the non-electrical cardiac activity; and
        identifying a cardiac signal based on the examination.

38.   The method of claim 37, wherein the non-electrical cardiac activity comprises a temporal location of a peak heart-sound.
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39.   The method of claim 37, further comprising identifying the detected electrical signal as a cardiac signal indicative of a cardiac condition.

40.   The method of claim 37, wherein examining the electrical signal
25   comprises providing a detection window.

41.   The method of claim 40, further comprising detecting a QRS complex within the detection window.

42.   The method of claim 37, further comprising correlating the received non-electrical cardiac activity with the electrical signal.

5   43.   The method of claim 37, further comprising determining a time separation between a peak of the non-electrical cardiac activity and a peak of the electrical signal.

44.   The method of claim 43, wherein the time separation is used to identify

10 a cardiac signal.

45.   The method of claim 37, further comprising identifying the detected electrical signal as a cardiac signal indicative of a cardiac condition and treating the cardiac condition.

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46.   The method of claim 45, wherein treating the cardiac condition comprises delivering a cardiac therapy.

47.   The method of claim 45, wherein the cardiac therapy comprises a

20 cardiac pacing therapy.

48.   The method of claim 45, wherein the cardiac therapy comprises a cardiac defibrillation therapy.